TS 6320 (US)
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	)	
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Hillegonda Bakker et al.	)	
	)	
Serial No. 10/500,280	)	Group Art Unit: 3744
	)	
Filed June 28, 2004	)	Examiner: John F. Pettitt
	)	
MULTISTAGE FLUID SEPARATION	)	May 5 , 2009
ASSEMBLY AND METHOD	)	
	)	

Mail Stop Appeal
Commissioner for Patents
P.O. Box 1450
Arlington, Virginia 22313-1450

Appeal Brief

In response to the Final Office action of October 29, 2008, the following Appeal Brief is submitted. This brief is filed with a petition for a one-month extension for the time period to respond. The present appeal is taken from the action of the Examiner in finally rejecting claims 1-19. The full text of claims 1-19 in the Claims Appendix appended hereto.

Reconsideration of this application in light of this Appeal is respectfully requested.

i) Real Party in Interest

The present application is owned by Shell Oil Company, which is the real party of interest in the present appeal.

ii) Related Appeals and Interferences

Appellant is aware of no other appeals or interferences that will affect or be affected by or have a bearing on the Board's decision in the present appeal.

iii) Status of Claims

Claims 1-19 are pending. Claims 1-19 are under final rejection. **Claims 1-19 are appealed.**

iv) Status of Amendments

No amendments after final rejection have been requested.

v) Summary of Claimed Subject Matter

The present invention relates to a multistage fluid separation assembly. The assembly includes a plurality of primary gas cooling devices (which have liquefied and/or solidified condensables enriched fluid outlet, and a secondary fluid separation vessel having a tubular vertical section. The vessel is connected to the condensables enriched fluid outlet of the primary gas cooling devices cooling device(s) via a tangential conduit which injects the condensables enriched fluid tangentially into the tubular section such that a tertiary stream of liquefied and/or solidified condensibles is induced by gravity and centrifugal forces to swirl in a downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank at or near a bottom of the vessel for collecting a tertiary mixture of liquefied and/or solidified condensables. The tank is provided with one or more heaters for heating the tertiary mixture to reduce the amount of solidified condensables and with one or more outlets for discharging the tertiary mixture from the tank. The plurality of liquefied and/or solidified condensables enriched fluid outlets are connected at regular circumferential intervals to the tubular section of the secondary separation vessel and the enriched fluid outlets inject in use condensables enriched fluid in an at least partially tangential direction into the interior of the secondary separation vessel.

The specific invention that is the subject of this Appeal is set out below, as claimed in appealed independent claims 1 and 17. In the following paragraphs, reference numerals, if present, will be presented in **bold**, following the page and line number where the item or feature is disclosed.

Claim 1. A multistage fluid separation assembly comprising: a plurality of primary gas cooling devices (page 13 line 19 **31 and 31A**), each of which has a liquefied and/or solidified condensables enriched fluid outlet (page 14, lines 1-2, **33 and**

33A); and, a secondary fluid separation vessel (page 14, lines 3-4 **32**) having a tubular section of which a central axis has a substantially vertical or tilted orientation (page 14, lines 4-5, **41**), which vessel is connected to said condensables enriched fluid outlets of said primary gas cooling devices, wherein during normal operation of the vessel the condensables enriched fluid is induced to swirl around the central axis of the tubular section of the vessel such that a tertiary stream-of liquefied and/or solidified condensables is induced by gravity and centrifugal forces to swirl in a downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank (page 14, line 25, **49**) at or near a bottom of the vessel for collecting a tertiary mixture of liquefied and/or solidified condensables, which tank is provided with one or more heaters (page 15, line 15, **50**) for heating the tertiary mixture to reduce the amount of solidified condensables and with one or more outlets for discharging the tertiary mixture from the tank; wherein the plurality of liquefied and/or solidified condensables enriched fluid outlets are connected at regular circumferential intervals to the tubular section of the secondary separation vessel and the enriched fluid outlets inject in use condensables enriched fluid in an at least partially tangential direction into the interior of the secondary separation vessel.

Claim 17. A method of separating condensable components from a fluid mixture in a multistage fluid separation assembly, the method comprising:

injecting the fluid mixture into a plurality of primary gas cooling devices (page 13 line 19 **31 and 31A**) in which the fluid mixture is expanded and cooled and condensable components are liquefied and/or solidified and in each primary gas cooling device a stream of condensables enriched fluid components is fed into a secondary fluid outle t(page 14, lines 1-2, **33 and 33A**); and

injecting the stream of condensables enriched fluid components into a secondary fluid separation vessel (page 14, lines 3-4 **32**) having a tubular section of which a central axis has a substantially vertical or tilted orientation (page 14, lines 4-5, **41**) and in which the condensables enriched fluid stream is induced to swirl around the central axis of the tubular section of the vessel such that a tertiary mixture of liquefied and/or solidified condensables is induced by gravity and centrifugal forces to swirl in a

downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank (page 14, line 25, **49**) at or near a bottom of the vessel, in which tank the tertiary mixture of liquefied and/or solidified condensables is collected and heated to reduce the amount of solidified condensables and from which tank liquid and/or solidified components are discharged through one or more outlets; wherein a plurality of secondary fluid injection outlets are connected at regular circumferential intervals to the tubular section of the secondary separation vessel, and the enriched fluid outlets inject the condensables enriched fluid in an at least partially tangential direction into an interior of the secondary separation vessel.

(vi) Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-7, 12 and 16-19 are obvious over Atkinson (US 2,683,972) (hereafter Atkinson) in view of Engle (US 3,259,145) (hereafter Engle) .

Whether claim 8 is obvious in over Atkinson in view of Engle and Coggins et al. (US 4,208,196) (hereafter Coggins).

Whether claims 9 and 11 are obvious over Atkinson in view of Engle and Alferov et al. (US 6,372,019) (hereafter Alferov).

Whether claim 10 is obvious in over Atkinson in view of Engle, Coggins and Skrebowski.

Whether claims 13, 14, and 15 are obvious over Atkinson in view of Engle and Coggins et al. (US 4,208,196) (hereafter Coggins).

Claims 1-19 stand or fall together.

(vii) Argument

Applicants dispute the grounds of all of the rejections because the combination of references does not teach an apparatus meeting the limitations of claims. Each of the claims requires that a primary gas cooling device that has a liquefied and/or solidified condensables **enriched** fluid outlet (or stream) which passes to a secondary fluid separation vessel. For each of the rejections, the cold liquid fluid outlet of the vortex tube of Atkinson is cited as this element. The Examiner point to Atkinson's statement that water condenses along with condensable hydrocarbons as a result of reduced temperatures at cold end (14:column 3, lines 1-10).

Atkinson's cold outlet may contain condensables, but it does not contain a stream enriched in condensables. A vortex tube separates a high pressure vapor into two lower pressure streams, one hot and one cold stream. The cold stream is not "enriched" in condensables. In fact, the hot stream may contain a greater concentration of condensables (see US patent 6,932,858, "Vortex Tube System and Method for Processing Natural Gas" at column 2, lines 3-8, "**It has also been shown that the hot stream exists in a somewhat richer state, that is, more heavy components than the cold stream**…"). US patent 6,932,858 is included in the attached Evidence Appendix. The cold outlet stream from a vortex tube is therefore not a stream enriched in condensables, and this element is therefore not present in the art cited art. An examination of the workings of a vortex tube, for example figure 1 of US patent 6,932,858, and the accompanying text, clearly supports the statement that any change in compositions within a vortex tube would be enriching the hot stream in condensable material, not the cold stream. The cold stream 20 swirls inside of the hot stream 19, which is swirling and traveling axially in the opposite direction, toward the hot stream outlet 12. Liquids or solids in the swirling cold stream would tend to be forced outward by centrifugal force back into the hot stream, where they would be vaporized, and a portion of this material would then exit as a component of the hot stream.

The hot stream exiting a vortex tube may be a "condensables enriched stream", but the hot stream of Atkinson does not meet the limitations of the present claims because it is not, among other things, "induced to swirl around the central axis of the tubular section of the vessel such that a tertiary stream-of liquefied and/or solidified condensables is induced by gravity and centrifugal forces to swirl in a downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank…" as required by the present claims.

Atkinson discloses an apparatus that separates condensables from a stream by using a vortex tube to generate a hot stream, and a cold steam, the cold stream containing condensables. The condensables are then separated from the cold stream by centrifical separation. The hot stream and cold stream are recombined to produce a stream that is reduced dew point. Some heat from the hot stream is also used to melt hydrates, and by exchanging heat with the cold hydrates, more water or condensables condense from the hot stream and are separated.

For the foregoing reasons, Applicants submit that this ground of rejection is in error.

It is therefore submitted that claims 1-19 are patentable over the art of record. Accordingly, Applicants respectfully request reversal of the § 103 rejection and allowance of the rejected claims.

Respectfully submitted,

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Claims Appendix

1. (Previously Presented) A multistage fluid separation assembly comprising:

a plurality of primary gas cooling devices each of which has a liquefied and/or solidified condensables enriched fluid outlet; and,

a secondary fluid separation vessel having a tubular section of which a central axis has a substantially vertical or tilted orientation, which vessel is connected to said condensables enriched fluid outlets of said primary gas cooling devices, wherein during normal operation of the vessel the condensables enriched fluid is induced to swirl around the central axis of the tubular section of the vessel such that a tertiary stream-of liquefied and/or solidified condensables is induced by gravity and centrifugal forces to swirl in a downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank at or near a bottom of the vessel for collecting a tertiary mixture of liquefied and/or solidified condensables, which tank is provided with one or more heaters for heating the tertiary mixture to reduce the amount of solidified condensables and with one or more outlets for discharging the tertiary mixture from the tank;

wherein the plurality of liquefied and/or solidified condensables enriched fluid outlets are connected at regular circumferential intervals to the tubular section of the secondary separation vessel and the enriched fluid outlets inject in use condensables enriched fluid in an at least partially tangential direction into the interior of the secondary separation vessel.

2. (Previously Presented) The fluid separation assembly of claim 1, wherein the liquid collecting tank comprises an upper liquid outlet for low density liquid components and a lower liquid outlet for high density liquid components.

3. (Previously Presented) The fluid separation assembly of claim 1, wherein the tubular section of the secondary separation vessel is equipped with a tertiary gas outlet conduit having an inlet which is located at or near the central axis of the tubular section.

4. (Previously Presented) The fluid separation assembly of claim 3, wherein the secondary separation vessel has a dome or disk shaped top which is mounted on top

of the tubular section and the tertiary gas outlet conduit is arranged substantially co-axial to the central axis of the tubular section and passes through said top.

5. (Previously Presented) The fluid separation assembly of claim 1, wherein the liquefied and/or solidified condensables enriched fluid outlet of at least one primary gas cooling devices injects in use the condensables enriched fluid in an at least partially tangential direction into the tubular section of the secondary separation vessel.

6. (Previously Presented) The fluid separation assembly of claim 5, wherein the central axis of the tubular section of the secondary separation vessel has a substantially vertical orientation and said plurality of primary gas cooling devices each of which has a liquefied and/or solidified condensables enriched fluid outlet inject in use condensables enriched fluid in an at least partially tangential and partially downward direction into the interior of the secondary separation vessel.

7. (Previously Presented) The fluid separation assembly of claim 1, wherein the liquid collecting tank is formed by a cup-shaped tubular lower portion of the secondary separation vessel which is substantially co-axial to the central axis and has a larger internal width than the upper portion of the vessel.

8. (Previously Presented) The fluid separation assembly of claim 1, wherein a vortex breaker is arranged in the interior of the secondary separation vessel between the lower end of the tubular section and the liquid collecting tank.

9. (Previously Presented) The fluid separation assembly of claim 1, wherein the assembly is provided with one or more ultrasonic vibration transducers for imposing ultrasonic vibrations on one or more components of the assembly to inhibit deposition of solidified condensables, such as ice, wax and/or hydrates, within the assembly.

10. (Previously Presented) The fluid separation assembly of claim 8, wherein at least one of the plurality of primary gas cooling devices, each of which has a liquefied and/or solidified condensables enriched fluid outlet and the vortex breaker, are equipped with ultrasonic vibration transducers.

11. (Previously Presented) The fluid separation assembly of claim 9, wherein the ultrasonic vibration transducers are designed to vibrate in use one or more components of the assembly at a frequency between 20 and 200 KHz.

12. (Previously Presented) The fluid separation assembly of claim 1, wherein the liquid collecting tank is provided with a grid of heating tubes which are designed to heat the liquid and solid fluid mixture in the tank to a temperature of at least 15 degrees Celsius.

13. (Previously Presented) The fluid separation assembly of claim 1, wherein at least one of the plurality of primary gas cooling devices, each of which has a liquefied and/or solidified condensables enriched outlet, comprises a primary cyclonic inertia separator comprising an expansion nozzle in which the fluid mixture is cooled to a temperature lower than 0 degrees Celsius by a substantially isentropic expansion and in which one or more swirl imparting vanes induce the fluid to swirl into a diverging outlet section which is equipped with a central primary condensables depleted fluid outlet conduit and an outer secondary condensables enriched fluid outlet conduit.

14. (Previously Presented) The fluid separation assembly of claim 13, wherein each primary cyclonic inertia separator comprises an expansion nozzle designed to accelerate the fluid mixture within the nozzle to a supersonic speed, thereby cooling the temperature of the fluid passing through the nozzle to a temperature lower than -20 degrees Celsius.

15. (Previously Presented) The fluid separation assembly of claim 13 comprising a plurality of primary cyclonic inertia separators of which the expansion nozzles are substantially parallel and equidistant to the central axis of the tubular section of the secondary separation vessel and of which the secondary condensables enriched fluid outlets are connected to secondary fluid injection conduits which intersect the wall of the tubular section of the secondary separation vessel at regular circumferential intervals and in an at least partially tangential direction, and which secondary fluid injection conduits each have a length less than 4 meters.

16. (Previously Presented) The fluid separation assembly of claim 1, wherein the gas cooling devices comprise chokes.

17. (Previously Presented) A method of separating condensable components from a fluid mixture in a multistage fluid separation assembly, the method comprising:

injecting the fluid mixture into a plurality of primary gas cooling devices in which the fluid mixture is expanded and cooled and condensable components are liquefied and/or solidified and in each primary gas cooling device a stream of condensables enriched fluid components is fed into a secondary fluid outlet; and

injecting the stream of condensables enriched fluid components into a secondary fluid separation vessel having a tubular section of which a central axis has a substantially vertical or tilted orientation and in which the condensables enriched fluid stream is induced to swirl around the central axis of the tubular section of the vessel such that a tertiary mixture of liquefied and/or solidified condensables is induced by gravity and centrifugal forces to swirl in a downward direction alongside an inner surface of the tubular section of the vessel into a liquid collecting tank at or near a bottom of the vessel, in which tank the tertiary mixture of liquefied and/or solidified condensables is collected and heated to reduce the amount of solidified condensables and from which tank liquid and/or solidified components are discharged through one or more outlets;

wherein a plurality of secondary fluid injection outlets are connected at regular circumferential intervals to the tubular section of the secondary separation vessel, and

the enriched fluid outlets inject the condensables enriched fluid in an at least partially tangential direction into an interior of the secondary separation vessel.

18. (Previously Presented) The method of claim 17, wherein the fluid mixture is a natural gas stream which is cooled in the gas cooling devices comprising one or more primary cyclonic inertia separators to a temperature below 0 degrees Celsius thereby condensing and/or solidifying aqueous and hydrocarbon condensates and gas hydrates and the tertiary fluid mixture comprises water, ice, hydrocarbon condensates and gas hydrates and is heated in the tertiary fluid collecting tank to a temperature above 15 degrees Celsius to reduce the amount of gas hydrates, and from which tank low density hydrocarbon condensates are discharged through an upper liquid outlet and high density aqueous components are discharged through a lower liquid outlet.

19. (Previously Presented) The method of claim 17, wherein liquefied and/or solidified components are separated from the gaseous components by centrifugal force in the primary gas cooling device.

Evidence Appendix

US Patent 6,932,858

Related Proceedings Appendix

N/A

Related Proceedings Appendix

N/A